Student Name:
Student ID:

COURSE **ELECTRICAL ENGINEERING 2FH3**

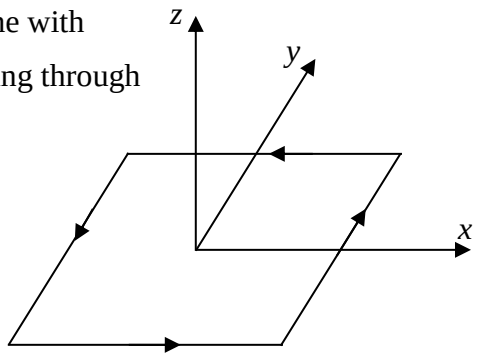
Duration of Examination: **2 hours**
Second Midterm Examination March 24th, 2014

THIS EXAMINATION PAPER INCLUDES **2 PAGES** AND **5 QUESTIONS.** YOU ARE RESPONSIBLE FOR ENSURING THAT YOUR COPY OF THE PAPER IS COMPLETE. BRING ANY DISCREPANCY TO THE ATTENTION OF YOUR INVIGILATOR.

Instructions:
1. You can use only a standard calculator (Casio-FX991).
2. Write your name and student ID on each page, the exam booklets incl.
3. You are allowed to bring 2 sheets of letter-size paper with any writing on both sides of the sheet.
4. Attempt all questions.

Question 1 [30 points]

Consider the shown square loop. The loop, which lies in the *xy* plane with centre at the origin, has a side length of 10.00 cm. The current *I* going through the loop is 2.0 A. Find:



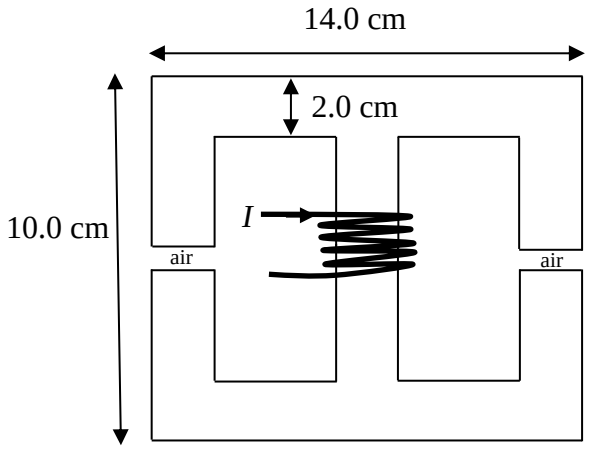
a) the magnetic field strength **H** at (0,0,0) m

b) the magnetic field strength **H** at (0,0,0.5) m

c) if a charged particle with charge of 0.1 nC and velocity **u**=5.0 $\mathbf{a}_y$ m/s is at the point (0,0,0.5) m, evaluate the magnetic force affecting this particle.

Question 2 [20 points]

Consider the shown magnetic circuit. The current is 5.0 A and the number of turns is 100. The magnetic core has a relative permeability of μ_r=1000. The air gaps have a length of 4.0 mm each. The cross section area of all arms is 4.0 cm^2. Find:



a) the magnetic flux ψ in all arms

b) the magnetic flux density in all arms

c) the magnetomotive force across air gaps

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Question 3 [20 points]

The magnetic vector potential in free space due to a certain current is given by $\mathbf{A}= 10\rho^2\times10^{-6}\ \mathbf{a}_z$ Wb/m. Find:
a) the magnetic flux density vector **B**
b) the magnetic field strength **H**
c) the current density **J**
d) the current flowing through the surface z=1, $0 \le \rho \le 2$, $0 \le \varphi \le 2\pi$.

Question 4 [20 points]

A current sheet with $\mathbf{K}$=10 $\mathbf{a}_x$ A/m lies in free space in the z=2 plane. A filamentary conductor on the x-axis carries a current of 2.5 A in the $\mathbf{a}_x$ direction. Determine the force per unit length on the conductor.

Question 5 [20 points]

Inside a right circular cylinder whose axis is the z-axis, we have μ_1=400 μ_o, while the exterior is free space. Given that $\mathbf{H}_1$=22 $\mathbf{a}_\rho$+45 $\mathbf{a}_\varphi$ A/m inside the cylinder, find $\mathbf{B}_1$, $\mathbf{M}_1$, $\mathbf{B}_2$, $\mathbf{H}_2$, and $\mathbf{M}_2$.

END OF QUESTION SHEET
TOTAL MARKS FOR THIS EXAM = 100 plus 10 bonus marks